REMARKS

To expedite the process, new claims are added and some claims are amended, in case the restriction is maintained although the application owner still preserve the right petition should the restriction is made final.

Claim 1 is amended to include all the limitations describing the main inventive concept – a three-dimensional non-linear ion trap mass spectrometry. Furthermore three other important concepts are: a) switching the ion trap between a three-dimensional mode and a two-dimensional mode, by cutting the ring electrode into and operating on the multiple pieces; b) superimpose a DC octopole field on a main quadrupole field, by cutting the cap electrodes into and operating on multiple pieces, c) operating the ion trap for ion mass analysis. These concepts work together to provide a complete analysis solution.

Claim 64 is added to include means for operating the ion trap for ions mass analysis. Claim 65 is added to include operating the ion trap between a three-dimensional mode and a two-dimensional mode. Claim 2 is amended to be dependent on claim 65 which discloses a specific way of operating the ion trap in three-dimensional mode, by cutting rotationally symmetric ring electrode into multiple pieces. Claim 66 is added to cover how to specifically operate on the multiple cut ring electrodes for switching modes.

Claim 3 is amended to be dependent on claim 1 which discloses an embodiment implementing the various means in the broad concept in claim 1. Claim 4 is amended to be dependent on claim 1 to cover a specific ring electrode shape. Claim 5 is original and claim 6 is cancelled. Claim 7 covers specific means in claim 1 having ring electrode shape as in claim 4.

Claim 66 is added to cover a two-dimensional version of corresponding claim 1, which originates from the same concept as claim 1. Claim 8 covers a specific two-dimensional ion trap structure in claim 66. Claims 9-11, 13, 14 are original which cover further details of the two-dimensional ion trap structure. Claim 12 covers specific embodiments of various means in claim 66. Claim 15 covers a application tool based on the two-dimensional ion trap in claim 8.

Claim 16 is cancelled. Claims 17-21 cover specific ways of cutting the ring electrode into multiple pieces in claim 2. Claim 22-24 cover how to operate the ion trap to switch between two modes when the ring electrode is cut into multiple pieces. Claims 25-56 further cover the functionalities of the ion trap when it operates under three-dimensional and two dimensional modes. Claim 27-28 are cancelled.

Claims 29-31, 33-35, 37-39, 41-42 cover methods of operating the ion trap for ion mass analysis, while claim 32, 36, 40 are cancelled. Claim 43-45, 47-55 cover applications where the disclosed ion trap is operating within a vacuum chamber, and further more a low pressure vacuum chamber, while claims 46, 56-58 are cancelled.

Claims 59-60 further expand the ion trap low pressure application to general ion trap other than what disclosed and claimed in current invention, which includes Paul trap.

Claim 61 covers one of the important concepts in this invention: superimpose a DC octopole field on a main quadrupole field, by cutting and operating on the cap electrodes into multiple pieces. Claim 62 covers another important concept in this invention: switching the ion trap between a three-dimensional mode and a two-dimensional mode, by cutting the ring electrode into and operating on the multiple pieces. Claim 63 covers a specific ring electrode shape in claim 62.

The claims are amended to follow the general claim 1, and the new claim listing should be searched and examined all together without serious burden.

Accordingly, search of the new claim set will necessarily involve looking for the same invention without serious burden.

No fee is believed to be due.

Respectfully submitted,

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The examiner has not shown that the claims in each species "ARE PATENTANLE (novel and unobvious) OVER EACH OTHER." Should the requirement for restriction be made final, the examiner is respectfully requested to rule that the claims in each species "ARE PATENTABLE (novel and unobvious) OVER EACH OTHER."

The examiner has made no showing whatsoever that the inventions are INDEPENDENT. M.P.E.P. 803 provides, "If the search and examination of an entire application can be made without serious burden, the examiner must examine it on the merits, even though it includes claims to distinct or independent inventions."

And M.P.E.P. 803.01 provides, "IT STILL REMAINS IMPORTANT FROM THE STANDPOINT OF THE PUBLIC INTEREST THAT NO REQUIEMENTS BE MADE WHICH MIGHT RESULT IN THE ISSUANCE OF TWO PATENTS FOR THE SAME INVENTION."

The main inventive concept of this application is a non-linear (three-dimensional or two-dimensional) ion trap mass spectrometry. Furthermore three other dependent important concepts are: a) switching the ion trap between a three-dimensional mode and a two-dimensional mode by cutting the ring electrode into and operating on the multiple pieces; b) superimpose a DC octopole field on a main quadrupole field by cutting the cap electrodes into and operating on multiple pieces, c) operating the ion trap for ion mass analysis. These concepts work together to provide a complete analysis solution.

Specifically, two further ion trap structures are disclosed implementing abovementioned concepts:

I: A multiple electrodes ion trap which generates a DC octopole field being superimposed on the main RF quadrupole field. When operating as a three-dimensional ion trap, DC octopole field is constructed by cutting two cap electrodes. When operating as two-dimensional ion trap, DC octopole field is constructed by adding a set of small rods electrodes. With disclosed various operating methods and electronics layouts, the mass-ion can be analyzed and mass resolution can be improved, especially, when the ion trap structure and its operating method operate in lower vacuum conditions of 10^{-2}-10^{-1} mbar.

II: A multiple electrodes ion trap which includes symmetrically cutting, in parallel to its central axis, ring electrodes. This ion trap can generate a three-dimensional ion trap or a two-dimensional multipole ion trap with various disclosed electronics layouts. With disclosed electronics designs, the ion trap can operate and switch in-between a three-dimensional mode and a two-dimensional multipole mode, which improves the ions trapping efficiency.

Species I claims the main inventive concept embedded in structure I in general. Species III claims a three-dimensional ion trap version and mass-analysis method to realize structure I. Species IV claims another three-dimensional ion trap to realize structure I. Species V claims a two-dimensional ion trap version and mass-analysis